

REMARKS

Favorable reconsideration is respectfully requested.

The claims are 1-12.

Claims 1-12 are rejected under 35 U.S.C. 102(b) as being anticipated by Obuchi et al. (US Patent 6,417,294).

Claims 1-12 are also rejected under 35 U.S.C. 103(a) as being unpatentable over Obuchi et al.

Applicants respectfully traverse each of these rejections.

In Section 5 of the Official Action, Applicant's argument made in the last reply (based on two filed references) that an increase in crystallinity of a crystalline thermoplastic resin does not substantially change the crystal melting point, or the viscoelastic properties of the resin is rejected. The Final Rejection argues that these references do not deal with the type of polyesters of the present application, that is, crystalline aliphatic polyesters. Instead, the Office Action relies upon the secondary references, Schmidt et al. (US'099) and Encyclopedia of Polymer Science and Engineering (EPSE) pgs. 197-198. This assertion is, however, not tenable.

First, the cited secondary references also deal with PET (polyethylene terephthalate, i.e., an aromatic polyester) alone, (see Schmidt et al. and EPSE), or in combination with MXD6 (polymetaxylylene adipamide, i.e., an aromatic polyamide). See Schmidt et al., Figure 5. In fact, these polyesters are also different from the crystalline aliphatic polyesters of the present invention.

Moreover, paragraph [0087] of Schmidt et al. compares the melting temperature in crystal form, i.e., the crystal melting point, and the melting point of a polymer. Schmidt et al. is directed to a solid-stating process, that is, a process where a polymer is exposed to heat under an atmosphere having a low oxygen content. See paragraph [0081]. For this purpose Schmidt et al. induces crystalline forms in an amorphous polymer by heating, rather than stretching, prior to solid-stating, as discussed at the bottom of paragraph [0087].

The EPSE reference at pages 197-198 refers to stress-induced crystallization, i.e., re-alignment of molecular chains, but does not mention an increase in crystalline melting point. A crystalline melting point is a heat-absorption peak temperature associated with the melting of a crystalline portion of a (semi)crystalline polymer. The crystalline melting point does not substantially change depending on the proportion of crystalline portions in a (semi)crystalline material. The EPSE reference does not disclose or suggest a stress-induced change in crystalline melting point.

The present invention is based on the discovery that only intense stretching, i.e., at a large stretching ratio, and at a temperature not substantially higher than the glass transition temperature (T_g) of a crystalline aliphatic polyester, results in the characteristic effects of the present invention. The characteristic effects of the present invention include: a substantial increase in crystal melting point, main and sub-dispersion peak temperatures according to dynamic viscoelasticity measurements which leads to substantial improvements in retort-durability, gas barrier property, and impact strength.

This is already clearly demonstrated in the present specification for polyglycolic acid (PGA) by a comparison between Examples 1-4 and Comparative Examples 1-6 in Tables 1-2 at page 24. Thus, the intense stretching effects can only be attained by stretching at a large ratio exceeding 3x3 times, and at temperatures of 45-60°C, and not substantially above the T_g of PGA. In evaluating the results in Tables 1 and 2, the following data of glass transition temperature (T_g) and melting point (T_m) for PGA and PLA are of interest.

	<u>T_g(°C)</u>	<u>T_m (°C)</u>
PGA	38-40	215-220
PLA	45-60	158-163

In contrast, Obuchi et al. only disclose that a container was formed from a parison of PLA after heating to 120 °C and blow expansion at ratios of twice in both the longitudinal and transverse directions in a mold maintained at 120 °C in an injection molding machine. See

Example 4-1 at col. 27, lines 39-43. These stretching conditions of 2x2 times at 120°C (compared with Tg=45-60°C of PLA) are clearly not intense, but mild, for PLA.

Obuchi et al. refers to stretching only in relation to blow forming, among the various forming methods disclosed at col. 15, line 63 to col. 16, line 4, and Example 4-1. In the former section, the mold temperature for blow forming is only referred to as between Tg (59 °C) and Tm (163 °C). Thus, Obuchi et al. fails to disclose intense stretching conditions as taught by the present invention.

Consequently, Obuchi et al. does not disclose or suggest a stretched aliphatic polyester product of the present invention, having a substantially increased crystal melting point, and substantially increased main and sub-dispersion temperatures compared with those of an unstretched product, and which is obtained through intense stretching of a crystalline aliphatic polyester resin.

TEST EXAMPLE

In order to support the above arguments, Applicants have conducted the following stretching test using polylactic acid homopolymer ("NATURE WORKS" made by Nature Work Co.; Tg = 55-60°C, Tm=160°C (catalog data); and Tg=57°C, Tm=163°C (as measured by Applicant), which are comparable to Tg=59 °C and Tm=163 °C disclosed by Obuchi et al. (col. 16, lines 1-2); and Mw =210,000-220,000 (PMMA polymethyl methacrylate based weight average molecular weight measured by GPC (gel permeation chromatography)) in parallel with PGA (showing a melt viscosity of 2500 Pa • s) as measured at a temperature of 240 °C and a shear rate of 100 sec⁻¹ used in the Examples of the instant application.

More specifically, each resin was extruded through a T-die at an extrusion temperature of 220-240 °C to form a cast sheet, from which a yet-unstretched sample sheet measuring 80mm x 80mm x 100 µm (thickness) was cut out, and the sample sheet was stretched at ratios of 2x2 times at a stretching speed of 7 m/min. (140% / sec.) at a stretching (preheating temperature) of 120 °C for PLA and 80 °C for PGA. As a result, the PLA sheet exhibited crystalline melting points of 163°C and 162°C before and after the stretching, respectively, and anti-impact strengths

of only 39 N (Force) and 0.06 J (Energy) after the stretching. Thus, the PLA sheet failed to exhibit the intense stretching effects of the present invention similarly as the PGA sheet stretched at ratios of 2x2 times at 80°C which exhibited an identical crystalline melting point of 218°C both before and after the stretching and anti-impact strengths of only 6N (Force) and 0.01 J (Energy) after the stretching.

Conclusion

No further issues remaining. Allowance of this application is respectfully requested.

If the Examiner has any comments or propose for expediting the prosecution, please contact the undersign at the telephone number below.

Respectfully submitted,

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